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BOTANICAL SKETCHES FROM THE ASIATIC TROPICS

BY HENRY ALLAN GLEASON

(Continued from August *Torreya*)

III. JAVA

The numerous walks and drives which branch off from Canary Avenue ramify in so many directions through the botanical garden that it is impossible to get a good impression of the place from a single walk through it. The casual tourist is guided along the main avenues only, and emerges with a confused jumble of impressions, but the botanist will explore all the by-paths, and devote a day or more to each section. Every part of the garden affords opportunity for interesting observations, and some of them are presented below. The order is that in which one might naturally study the garden, beginning at the main entrance, passing east to the Island, crossing again to the Proeftuin, and returning through the farther northern end of the garden to Canary Avenue and the Groote Weg.

Leguminous trees of many species are planted freely throughout the garden, but the chief collection of them is near the main entrance. It includes remarkably few species, for a tropical garden, and the liana forms are all relegated to the Island, with the exception of the famous specimens of *Entada scandens*.

This huge climber has a basal diameter of about a foot. It ascends diagonally through the air about forty feet to a *Parkia* tree, and branches in it at a height of about sixty feet. One branch loops down, and, rebranching at a height of ten feet, swings into two trees, distant respectively about sixty and eighty

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feet. The second main branch goes nearly horizontally into a *Pterocarpus* tree forty feet away, rests in a crotch there at a height of fifty feet, and then loops down and across some eighty feet to another tree, in which loops may be traced for at least eighty feet more. This branch is therefore approximately 260 feet long. Growing thus in the open, where its branches and swinging loops may be easily traced, this climber gives one a vivid impression of the huge dimensions reached by tropical lianas. There is a still larger specimen of the same species growing in the Economic Garden at Buitenzorg, which will be described in that connection.



FIG. 18. One of the main avenues through the botanical garden at Buitenzorg.

There are always several species of leguminous trees which exhibit the drooping young leaves, so characteristic of tropical vegetation. In *Amherstia nobilis* the leaves are produced in bunches of three. The internodes do not elongate till after leaf expansion is complete, so that the young clusters are quite compact. The young leaflets hang vertically along the rachis, and are each folded lengthwise along the midrib, the upper side in, and the margins cohering lightly. In the early stages, the color is a delicate semi-transparent reddish brown. The terminal leaflet expands most rapidly, and is followed in turn by the

lateral ones. As expansion continues, the red color is lost uniformly, the basal leaflets reach their normal proportions, the internodes elongate, and the petioles stiffen out, beginning at the base, until the leaves have reached their normal position.

In *Brownea hybrida* the red color is not lost uniformly, but in patches, so that the leaf becomes mottled green and red. The proportion of green increases as the leaf approaches maturity, but the leaflets remain appressed to the rachis until they are entirely green, and the whole leaf has reached its full size.

In several legumes the young leaves are almost colorless, and gradually assume the green color as they expand. In *Cynometra cauliflora* they are pink, and as delicately colored and almost as conspicuous as a cluster of flowers.

These bunches of drooping young leaves do not terminate every growing branch, but occur scattered here and there. On one spreading tree of thirty feet in height there were, for example, just six bunches. This indicates that, in Buitenzorg at least, the new leaves appear at no one particular season, but throughout the whole year. This is of course to be expected in a climate so uniform as that of western Java, but is in marked contrast to the obvious periodicity of vegetation in a region with sharply differentiated wet and dry seasons. *Amherstia nobilis*, for illustration, has large clusters of remarkably showy flowers, but in Buitenzorg, where a few clusters are always present, they attract no special attention. In Ceylon, however, where there is a definite blooming period, the tree becomes a most striking object when in full flower.

Beyond the legumes, one enters a collection of monocotyledonous plants, including the agaves, yuccas, dracaenas, and pandans. The representation of *Agave* and *Yucca* is poor, as might be expected in this humid climate, and offers nothing of note, although a few species of the former are generally in bloom. There are many species of *Dracaena*, affording one a better idea of the character of the genus than can be secured in an American greenhouse. Most species, of course, have sparingly branched stems, and their narrow foliage gives them a distinctly monocotyl appearance. One species, on the contrary, has a freely

branched stem and ovate-lanceolate leaves, giving it the general aspect of our cultivated mock-orange or *Philadelphus*.

There are many species of *Pandanus* in cultivation, showing all sorts of variation in habit. The trunks may be straight or crooked, erect or branching; the prop-roots few or many, thick or slender, straight or crooked, smooth or covered with lichens; the leaves long or short, green or glaucous, spreading or erect, straight or flexuous. One species, with very numerous branching prop-roots and divergent freely branched stems, receives and deserves the name *Pandanus labyrinthicus*. The prop-roots of one unnamed species are enormous, standing out perfectly

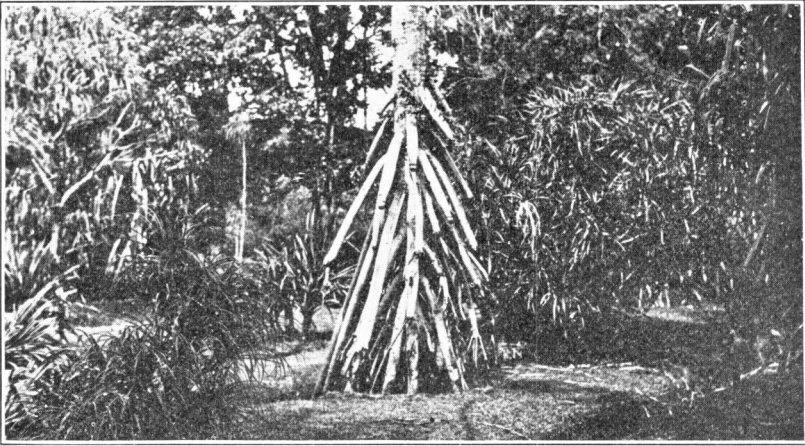


FIG. 19. *Pandanus* sp. with unusually large prop-roots.

straight at an angle of 45° from the stem, and reaching a diameter of six inches. Even these huge roots terminate in a regular root-cap, four inches in length and diameter. This particular tree was at least forty feet tall, with only three branches, and with leaves ten feet long. Many species bear fruit, varying from one to six inches in diameter, yellow or red in color, and looking rather like a pineapple. They fall to the ground when still hard, and decay under the trees, unless picked up by the natives.

Across from the pandan collection an opaque hedge of shrub-

bery bounds the fernery. One enters it under a huge tree of *Xanthophyllum excelsum*, five feet in diameter, and probably seventy-five feet high, with very dense foliage. It comes as a decided surprise to the visitor to learn that this giant tree belongs to the family Polygalaceae, a group represented in America by herbaceous plants of rather less than average height.

Within the fernery, the smaller species are planted in regular rows, and almost every tree supports one or two epiphytic forms. The most attractive display of epiphytes, however, comes from the hundreds of plants of *Asplenium nidus* which have established themselves everywhere in the taller trees, not only over the fern collection, but throughout the garden, until they must actually be treated as weeds and cleaned off the trees which they infest.

Tree ferns are noteworthy by their absence, and the botanist is disappointed to see so few and such poor specimens. Their place is taken in a way by hundreds of magnificent specimens of *Angiopteris evecta*, whose short stocky trunks are a foot or two high and almost as thick, and whose huge ascending fronds may be twelve feet long. In many places the walks are completely overarched by them.

There are numerous ferns represented by familiar generic names, but the botanist is most interested in seeing some of the rarer forms. There are two species of *Psilotum*, related to our *Lycopodium*; an epiphytic species of the latter genus; hanging fronds three feet long of *Ophioglossum pendulum*; delicate plants of the rare *Helminthostachys zeylanica*. There are several species of the stag-horn ferns, *Platycerium*, showing a large variation in the shape and position of the fronds. Of these the largest is perhaps *Platycerium coronarium*, with drooping fronds six feet long.

In connection with the fern collection, one must not omit mention of the little epiphyte *Drymoglossum heterophyllum*, whose specific name indicates the obvious difference between the foliage leaves and the sporophylls. The species occurs wild everywhere through the garden and city, on trees or walls, in deep shade or full sun, and seems to be perfectly adapted to

either condition. Although one soon becomes accustomed to seeing it in all sorts of habitats, it still looks decidedly out of place when scores of plants of it are found growing among the long spines of the cactus *Piereskia*.

Among the ferns is planted the small collection of bromeliads. Most of these are set out in beds along the walks, and only a few epiphytic species are shown, while all the species seem to have been chosen for their ornamental value rather than for their scientific interest. One is disappointed by the relatively small number of species, but it must be remembered that these plants are exclusively American, and must be more difficult to secure for a garden so far removed from the source of supply.

Just beyond the fern collection is the orchid section, and this is invariably one of the most attractive spots in the garden for the visitor. There are said to be over a thousand species in cultivation, and almost all of these are epiphytes. For a support the shrub *Plumiera acutifolia* is regularly used. Its rather stiff trunk is suggestive of our stag-horn sumach, and seems to be ideal for orchid cultivation. The shrubs are set out in regular rows, with paths between, and each one bears a single plant of some orchid. The few terrestrial orchids are planted in beds at the margin. The whole collection is shaded by some large trees of *Spondias*, whose fruits, the size of an unhulled walnut, are continually dropping.

Always there are a few species of orchids in bloom with large and showy flowers, and it is these which attract the casual visitor. No attempt is made, however, to provide a special display of flowers, and a more showy orchid collection can be found in any metropolitan American greenhouse. Only a small proportion of the species are in bloom at one time, and of them a majority have small or inconspicuous flowers. There is instead a remarkable variety of vegetative form, which is even more interesting to the botanist, since it offers a good illustration of the diversity of structure in this large family. There are leaves of every size, from the huge linear ones four feet long of *Cymbidium Finlaysonianum* to the rigid ones of *Dendrobium rigidum* or the terete ones of *Bulbophyllum alliifolium*, while *Vanilla*

aphylla is completely leafless. There are thigmotropic roots on the tree trunks, aerial roots with a silvery coating of velamen, for water absorption, and pseudobulbs at the base of the leaves occur in every size and shape.

Among the great multitude of species, two seem to be of special interest. One of these is the giant orchid *Grammatophyllum speciosum*, probably the largest known species of orchid, of which the largest known individual is one of the several planted in the Buitenzorg garden. Like most of the others, it is epiphytic. It grows completely around the trunk of a canary tree, about sixteen inches in diameter, at a height of about



Fig. 20. Portion of the orchid collection, Buitenzorg, Java.

fifteen feet from the ground. The dense mass of fibrous roots is over a yard in diameter, and two to four feet high. The numerous leafy shoots begin their growth in an erect direction, become declined and finally pendent from their own weight, and ultimately almost reach the ground. Their spreading or slightly ascending ends, however, indicate that they are naturally negatively geotropic. The rapidly growing young shoots, up to six feet in length, are leafy throughout. The old leaves soon die, leaving the basal portion of the stem covered with appressed scales, while only the terminal two or three feet is leafy. These

mature stems are as much as fifteen feet long, and an inch and a half in diameter, and the spreading or ascending leaves are sixteen inches long. The flower stalks are about six feet long, and bear a raceme three feet long and a foot in diameter, with probably a hundred flowers, each of a golden color with brown spots, and almost three inches wide. The lower flowers of the raceme are always sterile.

The second noteworthy orchid is *Dendrobium crumenatum*. It grows wild all through the garden, as an epiphyte on all sorts of trees, usually preferring the main trunk or the lower branches. It is inconspicuous in every way, and without flowers might pass completely unnoticed. But on January 31, 1914, thousands of individuals of the species burst into bloom at once, although not a single flower was open the preceding day. All over the garden, but especially among the more open plantings of the Island, the showy white flowers were very much in evidence. The next day they had all disappeared. On February 4 and 5, a few scattered individuals blossomed, but no other flowers appeared on the plants at any other time during our two months' stay at the garden. Just why the species should bloom on this particular day, or what environmental factor is the cause of such behavior, which is a regular characteristic of the species, is by no means apparent. It is probably on a par with the reported simultaneous blooming of the bamboo trees in India, or the appearance of the broods of seventeen-year locust in this country.

As a mere curiosity, mention should be made of the stemless and leafless orchid *Taeniophyllum Hasseltii*, whose slender hold-fast roots radiate over the surface of the canary trees, and give the plants the appearance of a long-legged spider.

Leaving the orchids, one passes through a small planting of cycads, and descends a little hill to the collection of aquatics. There are two artificial ponds, with numerous species planted close along the shore, within easy distance for inspection. The species exhibit the usual devices for floating, and most of the genera are familiar. Two or three forms exhibit aerenchyma, some along the stems and some on special erect roots. There are vigorous plants of *Victoria regia* and some interesting specimens of the aquatic fern *Ceratopteris*.

At one end of the ponds is a small artificial mangrove swamp, where two of these salt-marsh species are growing well, and exhibiting the two chief ecological features of the group. *Sonneratia acida* exhibits a great number of pneumatophores, straight, slender, narrowly conical, a foot or so long, and appearing by the hundred around the base of the tree. A *Rhizophora* bears fruit freely, and one can find all stages in the development of the long heavy hypocotyl while the seed is still attached to the parent tree, can hasten the fall of those nearly ripe, and watch them plant themselves by penetrating deeply into the mud below, and can find all stages of seedlings, from those recently fallen to those with several well developed leaves.

Next in order comes the collection of palms, occupying a large area, and containing certainly more than a hundred species. Here again the remarkable diversity of vegetative form is at once apparent. There are the straight smooth trunks of the royal palm, *Oreodoxa regia*, usually swollen near the middle, or the similar smooth trunks of *Oreodoxa acuminata*, swollen at the base. In *Caryota Rumphiana* the scars left by the fallen leaves are slightly rough, and the trunk is colonized by rings of epiphytes, occupying each node. In *Scheelea regia* the whole trunk is rough and covered with epiphytes. In *Vorschaffeltia splendida* the lower portion of the trunk has prop-roots, after the manner of a pandan. In *Corynophora gobanga* the persistent leaf bases are arranged in obvious spirals; in the sealing wax palm, *Cyrtostachys lakka*, the sheathing leaf bases are a bright red. Species of *Zalacca* and *Phytelephas* look like herbs rather than trees. *Raphia pedunculata* has an inflorescence twelve feet long, while in other genera the fruits may be in clusters only a few inches long. Many species have massive trunks, sometimes two feet in diameter, while the betel palm, *Areca catechu*, seldom exceeds six inches, and at maturity its height may be over a hundred times its diameter.

There are two or three plants of the Seychelles Islands palm, *Lodoicea seychellarum*, whose immense fruit, known as the double coconut, is seen in all botanical collections. These trees are all pistillate, and one is now bearing fruit, pollen having been sent

from the garden at Peradeniya, Ceylon. The fruit was only half grown when seen, but was reported as already six years old.

Beyond the palm collection, the bridge is crossed to the Island. At the south lies the shrub collection, containing a great variety of species, but with little of special interest, unless it be the yellow, leafless, dodder-like *Cassytha*, of the family Lauraceae. Beyond this is the herbaceous garden, laid off in regular rectangular beds, with walks between, and arranged in systematic sequence. The small space devoted to herbaceous plants, and the small number of species represented, impress one at once with the relatively larger number and greater importance of trees in the tropics. It also looks strange to see beds labeled with such familiar names as Cruciferae and Polemoniaceae, with not a single plant in them. Several American species are growing here, including *Portulaca oleracea*, *Verbesina virginica*, *Phytolacca decandra*, and *Physostegia virginiana*, and all of them look rather the worse for the humid tropical climate. A row of *Helianthus annuus*, however, stands full six feet high, and blossoms profusely. A few species of *Opuntia* look decidedly out of place, as do also the agaves and yuccas in another part of the garden.

Most of the Island is devoted to a collection of lianas. There are a great many species of Menispermaceae, Bignoniaceae, Leguminosae, Asclepiadaceae, and various other families, and most of them offer comparatively little of interest. Among the whole collection, however, a number of things are noteworthy.

Several species of the monocotyl *Flagellaria* are grown, which climb by a tendril terminating the leaf. This appears to be insensitive to touch, and becomes permanently coiled and indurated at maturity, even if not in contact with a support. There are a few species of *Nepenthes*.

Among the considerable collection of anonaceous lianas, the genera *Uvaria* and *Artabotrys* are especially well represented. At first sight it is not apparent how they climb. There are no aerial roots, they do not twine, and the whole mass is so loose that it appears ready to tumble down with any wind. Search soon shows that *Uvaria* has coiling twig bases, which may be a

half-inch in diameter, and extend out into normal leafy branches. *Artabotrys* has stiff short hooked tips on some twigs. These organs are quite few in number, but their size and strength apparently compensates for their numbers.

Other striking lianas are the great *Bauhinias*, with zigzag stems of very unsymmetrical structure, *Hippocrateas* with tendrils a foot long, and the icacinaceous *Phytocrene macrophylla*. The latter is especially conspicuous for its huge clusters of flowers and fruit, borne in globular clusters a foot in diameter on the old wood, and therefore exhibiting the well known tropical phenomenon called cauliflory. Many other species of plants in the garden illustrate the same habit, but the descriptions and photographs of cauliflorous trees in Schimper's *Plant Geography* are so familiar that further discussion is unnecessary.

At the extreme end of this collection is a large plant of the leguminous climber *Derris scandens*, with a basal diameter of about four inches. It is wound around the trunk of a good-sized tree, and branches freely on its way up. Some of these branches have been completely overgrown by the tree, so that portions of the climber disappear from view beneath the bark, to reappear as much as four feet away. In one or two places, even, the liana has branches whose point of origin is completely covered, so that the smaller stems appear to grow out from the host tree. Neither tree nor liana appear to suffer from the peculiar circumstance.

In this section of the garden, three or more species of the epiphytic genus *Dischidia*, of the family *Asclepiadaceae*, are common on trees, and show some remarkable adaptations for securing their water supply. Two or possibly more of these species, all without labels, have the same structure but differ merely in size. In the smaller the leaves are about an inch wide; in the larger, three inches. In both the leaves are orbicular or nearly so, lie closely appressed at their edges to the bark of the supporting tree, and are convex on the outer exposed surface, so that a free space is included behind the leaf. Here small quantities of rubbish collect and doubtless hold some water, while the roots which arise freely from the side of the stem penetrate this cavity and absorb water from it. Such a structure is of course essen-

tially analogous to that of the stag-horn fern, *Platynerium*, and is also imitated in a more irregular way by the bird's-nest fern, *Asplenium nidus*, and by various other epiphytes.

Dischidia Rafflesiana is the most remarkable species. Here the leaves are modified into urn-like pitchers, flattened-fusiform in shape, an inch in width and three or four inches long. These are generally grouped in clusters of five or six, and are spreading or pendent on their short petioles. Most of them contain water collected from the daily rains, and into them grow the roots. The habit of collecting water in similar cisterns may also be observed in various bromeliads, but this is the only plant in which water is absorbed from the cisterns by roots of the usual type. All of these species are common in the garden, and are frequently seen growing wild on various sorts of trees. Those with appressed convex leaves appear to be limited to the trunks of trees, while *D. Rafflesiana* may establish itself among the branches. In fact, the first one found was on the branches of a *Pandanus* which had been cut down.

Beyond the Island in the Proeftuin, are seen several species of economic plants of interest. The main avenue is shaded with some rubber trees, *Hevea brasiliensis*, now about ten years old, but already thirty feet high and tapped for rubber. Their fruit, much like that of a castor bean but twice as large, apparently explodes while still on the tree, since fruits with sound seeds are never found on the ground beneath. There is also a plantation of *Erythroxylon coca*, the source of the drug cocaine. These small shrubs look very much like our American *Nemopanthus mucronata*.

Returning now to the mainland, and turning at the bridge toward the farther end of the garden, the visitor enters a collection of forest trees, set out in no regular order. In the lower ground there are several species of figs, some of considerable size and with a great development of buttress roots. These roots extend out in every direction, are generally crooked and freely branched, and lack entirely the size and the peculiar flatness of the figs of Philippine forests. With them are a few very old canary trees, one of which covers with its buttress roots a ground

diameter of thirty-five feet. Even some oaks show a slight development of buttresses, extending out horizontally three or four feet from the trunk. These Javan oaks have oblong entire leaves, while the peculiar structure of the acorn cup shows that they belong to an entirely different section of the genus from our American species.

On the higher ground here is the collection of Dipterocarpaceae, without doubt the most important family of timber trees in the whole Malayan region. All genera of the family are represented except two, and many of them may be found in fruit, so that the botanist can become quite familiar with these interesting trees. The calyx lobes, enlarging in fruit, act as wings for wind distribution in many genera, while in others the fruit is heavier, the calyx lobes not enlarged, and the fruit seems to have no special method of dispersal. Those of the latter type may be found under the trees where they have fallen, but the winged species are scattered by the wind and it is sometimes difficult to associate the fruit with the proper species of tree. Some of these weigh as much as an ounce, with wings six inches long, and are probably the heaviest fruits normally distributed by the wind.

This circuit of the garden brings the visitor back to Canary Avenue. Crossing it, he enters the collection of shade plants, growing in narrow beds under a dense canopy of trees and shrubs. Here are aroids, elatostemmas, begonias, peperomias, calatheas, and many other shade-loving species. The most interesting plants, however, are the gingers and marantas. Next to the bananas, these families include the largest species of monocotyledonous herbs. Three or four species exceed ten feet in height, while the huge stems of *Nicolaia speciosa* arch over the paths and reach lengths of at least eighteen feet. Other species are of course much smaller, and some are mature and bearing flowers at a height of two feet.

The ginger flower clusters are most striking, and exhibit a great variation in size. In a few, the clusters are almost sessile at the base of the stems. Thus in *Achasma foetans*, the peduncles are only two inches high, but the flowers are vivid scarlet in color and three inches wide. In other species the peduncles stand six

feet tall, with flower clusters six inches across, while the colors are orange, or scarlet, or deep crimson. In every case the flower cluster is a dense head, in which the chief color comes from the conspicuous bracts, while the individual flowers are small and by no means showy. The outer bracts are usually somewhat larger, and spread horizontally, thus simulating the rays of a composite. Within these the flat cluster of flowers blooms centripetally, so that the resemblance to a composite head is quite noticeable. After blooming the bracts wither, and the heads of subspherical fruits become ovoid. Few tropical plants are so conspicuous when in bloom as these gingers, with their

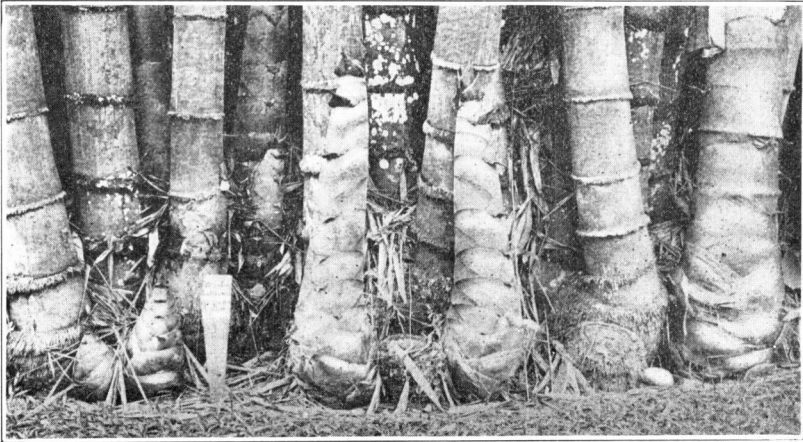


FIG. 21. Old and young stems of *Dendrocalamus giganteus*.

tall, gracefully curved stems and stiff erect peduncles with crimson heads.

Lastly, before leaving the garden, one reaches the collection of bamboos. The largest species here is the famous *Dendrocalamus giganteus*, of which two clumps are planted. These are now fourteen years old and about ten feet in diameter. The individual stems are at least sixty and probably nearer eighty feet high. The diameter of the mature stems averages six to eight inches, but seems to be increasing with each successive generation, for new canes now coming up have a diameter of as much as a foot.

Most of these new canes appear at the margin of the clump, so that its diameter increases from year to year. Others come up just within the margin, but so dense is the clump that it could not be observed whether there are any new central canes or not. At each node there is a large brown leathery sheath, more or less triangular in shape, so that a portion of the stem is exposed, although the sheaths are more or less overlapping. At the apex each sheath bears a dull brown ascending or divaricate leaf rudiment, which soon falls off. As the plant becomes older, a zone of adventitious roots is formed just above the base of each sheath. Shortly after the sheath breaks loose at the base and



FIG. 22. Inflorescence of *Nicolaia* sp.

ultimately falls off. It gives the impression of being pushed off by this zone of roots, as indeed it may be.

The sprouts of other species look much the same, differing naturally in proportions and size. When offered for sale in the market, the sheaths are neatly removed, exposing a conical tip. At the hotels these sprouts appear cut up in strips and stewed.

The leaves do not begin to unfold until the stem has reached full size. If it chances to be taller than other stems of the same clump, it makes a conspicuous sight with its leafless erect branches. The final appearance of the basal part of the thicket depends on

the species. The sheaths may be persistent or deciduous; there may or may not be thorny leafless axillary branches; there may be short accessory leaf-bearing branches. In one extreme, the result is a leafy tangle or jungle of thorns, in which the main stems are almost invisible and quite unapproachable; in the other the perfectly smooth jointed stems bearing leaves only near the top. *Bambusa Blumena*, the common building material of the Philippine Islands, is of the former type, *Dendrocalamus giganteus* of the latter.

(To be continued)

SOME PLANTS FROM THE VICINITY OF THE ARAPAHOE GLACIER.

BY T. D. A. COCKERELL

Looking west from the town of Boulder, Colorado, up Boulder Canyon, the skyline is formed by the Arapahoe Peaks, with the highest summit some 13,500 feet above sea level. On the face of this mountain is a large white area, the Arapahoe glacier; now greatly reduced from its original size, but still a moving mass of ice. The glacier is at the end of a narrow valley, occupied by quantities of morainal matter, the successive deposits of which, crossing the valley, have given rise to a series of small lakes. The lakes or ponds near to the glacier are of a most beautiful green color, presumably due to the suspension of exceedingly fine particles, ground by the slowly moving ice. On the south side of the valley or gulch, extending eastward from the peaks, is an enormous upland area, in places very rocky, with one especially large rounded elevation known as Baldy Mountain. This region is all above timber line, with elevations of between 11 and 12 thousand feet. It is bounded below by the dense forests of the Hudsonian Zone, consisting mainly of Engelmann spruce. On July 24, 1915, the Arapahoe Peaks were visited by the summer school of the University of Colorado. Accompanying the expedition, I did not attempt to climb to the highest point, which offers nothing of botanical interest, but contented myself with exploring, as well as the time permitted, the elevations extending along the south side of the gulch,